129. (new) A device comprising:

a first electronic device;

a second electronic device; and

at least one carbon nanotube, wherein the said carbon nanotube is electrically coupled to said first electronic device and said second electronic device.

130. (new) A device of claim 129, wherein said carbon nanotube is a vertically oriented carbon nanotube.

131. (new) A device of claim 129, wherein said carbon nanotube is a horizontally oriented carbon nanotube.

132. (new) A device comprising:

at least one vertically oriented carbon nanotube; and

at least one horizontally oriented carbon nanotube, wherein the said horizontally oriented carbon nanotube is electrically coupled to the said vertically oriented carbon nanotube.

133. (new) A plurality of carbon nanotubes in a substrate comprising:

a first carbon nanotube;

a second carbon nanotube; and

wherein said first carbon nanotube crosses path with said second carbon nanotube at a point such that said first carbon nanotube and said second carbon nanotube are electrically coupled.

REMARKS

Applicant has carefully considered the office action and respectfully requests that the Examiner reconsider the division of the species based on the following remarks.

Applicant believes that the division of the claims should be divided into the following species based on the organization of the specification and the fact that the subject of the specification is directed to carbon nanotube logic devices, components

of the carbon nanotube logic devices, and the method of their fabrication. All references to pages and paragraphs are taken from the published application.

Species 1: Carbon nanotube interconnects

Species 2: Carbon nanotube logic devices

Species 3: Template devices

Applicant submits the following remarks in support of the division of the species as outlined above.

Species 1: Carbon nanotube interconnects

The carbon nanotube interconnects are described in a separate section in the patent specifications, "Carbon Nanotube Interconnects," described in Par. 66 to Par. 70, Page 6, and on a different level through the document. For example, the specification states: "None of the state-of-the-art research has addressed the scalability of fabricating carbon nanotube based molecular electronic devices, their interconnection, and interconnection between the molecular logic device and the outside world." (Par. 12, Page 2). The specification further states: "Another advantage of the design is that it includes interconnects between the carbon nanotube devices and interconnects with the outside world." (Par. 14, Lines 12-15, Page 2).

The specification further lists examples of the problems that this innovation solves by stating: "The present fabrication process solves the problem of interconnects among the individual carbon nanotube devices and an interconnect to an external world. The present process involves fabrication of horizontal and vertical interconnects as part of the integrated fabrication process. Horizontal interconnecting is achieved by patterning metal interconnect lines in a plane sandwiched between substrate layers, combined with fabricating vertical nanotubes that pass through the metal interconnects. Alternative horizontal interconnects are achieved with the help of horizontal carbon nanotubes. Alternative horizontal interconnects are achieved by expanding the carbon nanotubes' diameters until two adjacent nanotubes touch. Vertical interconnects are achieved with the help of vertical conductive carbon nanotubes and by stacking one carbon nanotube device on top of another. Existing methods of interconnecting carbon nanotube devices rely on external contacts or on

interconnects that are fabricated separately from the nanotubes. There are no existing vertical interconnect technologies." (Par. 53, Lines 12-15, Page 5).

The specification further discusses carbon nanotube molecular electronic devices and the nanotube interconnects: "These carbon nanotube devices may be interconnected to create and utilize carbon nanotube transistors and other similar devices. These interconnects may comprise carbon nanotube-to-carbon nanotube, or carbon nanotube-to-metal, or carbon nanotube-to-another-like-conducting-material. The electrical or chemical etching processes may be manipulated so as to produce templates with distributed and desired density patterns of carbon nanotube devices which, when interconnected, may comprise a full working logic device." (Par. 105, Lines 24-33, Page 9).

Species 2: Carbon nanotube logic devices

The architecture of the carbon nanotube logic devices from species 2 are described in several sections in the patent specifications, including: the patent specification summary in Par. 55, Page 5, in the section "Innovative basic CNMEDs and complex devices in a 3-D architecture of CNMEDs," described in Par. 59 to Par. 60, Page 5, and in detail in the section "Carbon nanotube molecular electronic devices," described in Par. 98 to Par. 104, Pages 8 and 9. Different aspects of the nanotube logic devices and their components are also described on different levels throughout the specification.

Species 3: Template devices

The architecture of the template devices from species 2 are described in several sections in the specification, including the section "Control of the carbon nanotube discontinuities," described in Par. 81 to Par. 87, Page 7. Different aspects of the template devices are also described on different level through the specification.

Description of Figures

Applicant believes that it is obvious from the specification and the figures that support exists for both the process and the device claims. Applicant believes that it is obvious from the specification that each figure may support more than one species.

Applicant submits that, without placing any limitations, the following figures could be used to support the following species:

Figures supporting Species 1 (Nanotube interconnects devices) are: figure 2, figure 8, figure 13.

Figure 2 illustrates "FIGURE 2 shows schematic representation of a portion of a carbon nanotube molecular electronic device architecture, including vertical metallic nanotube interconnects and horizontal metallic film interconnects;" (Par. 26, Page 3).

Figure 8 illustrates one nanotube-to-nanotube interconnect and one metal interconnect that connects two carbon nanotubes. Figure 8 further illustrates a particular case of nanotube to nanotube interconnection: "FIGURE 8 shows method for establishing direct lateral connection between adjacent carbon nanotubes by sufficiently expanding nanotubes' diameters;" (Par. 32, Page 3).

Figure 13B, illustrates another example of vertical nanotube interconnects that were fabricated after the device was fabricated as illustrated in Figure 13A. While Figure 13 does not explicitly show the carbon nanotube grown in the template, it is described elsewhere in the specification: "For any template that can be fabricated, a corresponding carbon nanotube can also be fabricated." (Par. 99, Lines 6-8, Page 8).

Figures supporting Species 2 (Nanotube logic devices) are: figure 1, figure 2, figures 3, 4, figures 6, 7, figures 8, 12, 13.

Figure 1 illustrates one of the ways to achieve rectifying behavior of a carbon nanotube as bases for a logic device, "The structural defects (pentagon-heptagon pairs) produce a discontinuity in conductivity, believed to be the origin of the experimentally observed rectifying behavior;" (Par. 25, Page 3). In the preferred embodiment, the rectifying behavior of a carbon nanotube is achieved by design of the nanotube discontinuities where "... Preferably, the discontinuities will be introduced by exploiting the process of controlled electrochemical etching to vary the template diameter and shape along its length. The introduction of controlled discontinuities in the structure of the carbon nanotubes alters the bond configuration, and therefore the conductivity properties, at various points along the vertical axis of the nanotube." (Par. 58, Page 5). It is implied that the nanotube logic devices

described in the specification will function as logic devices even if the rectifying behavior of the nanotube may be formed by other means. One such example is to change the nanotube chirality along it length.

Figure 2 illustrates a complex "... 3-D architecture of carbon nanotube molecular electronic devices." (Par. 40, Lines 1-2, Page 3). Figure 2 also illustrates carbon nanotube molecular electronic devices on a single layer "Electronic device 10 comprises a plurality of vertically aligned carbon nanotubes 14 that are grown from a first contact plane 16. The vertically aligned carbon nanotubes 14 are grown within vertically aligned holes within a substrate material. A contact plane 20 is provided allowing conducting interconnects 22 to contact the gates 24 of vertical carbon nanotube transistors 14." (Par. 40, Lines 8-12, Page 3). Figure 2 further illustrates an example of a type of individual carbon nanotube molecular electronic device with two defects and three different conducting regions "A single carbon nanotube segment 14 will have two defects which divide the carbon nanotube 14 into three different conducting regions 36, 38 and 40 along the length of the nanotube." (Par. 40, Lines 19-22, Page 3). Each carbon nanotube molecular electronic device includes substrate with integrated electrodes in addition to the carbon nanotube part. Other types of individual carbon nanotube molecular electronic devices are described in the section "Carbon nanotube molecular electronic devices," Par. 98 to Par. 104, Pages 8 and 9.

Figures 3 and 4, illustrate one possible architecture of the carbon nanotube part of the molecular electronic device. The device electrodes are illustrated in Figure 3. Figure 3 illustrates an individual nanotube device and Figure 4 illustrates an array of nanotube devices. Figure 3 illustrates the carbon nanotube synthesized in the template.

Figures 6 and 7 illustrate other possible architectures of the carbon nanotube part of the molecular electronic device. The architecture in Figure 6A is same as the one shown in Figure 3. Figures 6 and 7 do not explicitly show the carbon nanotube synthesized in the template but it is described in the specification: "The present disclosure describes in detail the methods of changing the shape of the template and with that the shape of the synthesized carbon nanotube. The change of the carbon nanotube shape introduces controlled discontinuities in the structure of the carbon nanotube." (Par. 49, Lines 12-17, Page 4).

Figures 8, 12 and 13 illustrate a molecular electronic device made of two carbon nanotubes. The figures do not explicitly show the carbon nanotube synthesized in the template but for any template that can be fabricated, a corresponding carbon nanotube can also be fabricated. Figure 8 explicitly illustrate at least one integrated electrodes part of the molecular electronic device. In Figure 8, 12A, and 13, two carbon nanotube parts are parallel to each other over the length of the device as opposed to being partially parallel as in Figures 7A-7C. In Figure 12B the two nanotubes are stacked on top of each other, like in Figure 6C. In Figure 12C the nanotubes are slanted with respect to each other over the length of the device.

Figures supporting Species 3 (Template devices) are: figures 3, 4, figures 6, 7, figures 8, 12, 13, figure 11, and figures 9, 10, 11.

Figures 3 and 4, illustrate one possible architecture of the templates used to synthesize carbon nanotubes. The templates may be used as devices without the carbon nanotube synthesized within. Figure 3 shows an individual template and Figure 4 shows an array of templates.

Figures 6 and 7 illustrate other possible template designs. The specification states "Preferred discontinuities comprise variations in the diameters of the templates along their lengths, producing serial segments with different diameters. An alternative way to produce discontinuities is to divide or branch the templates along their lengths, producing parallel segments with different diameters." Par. 44, Lines 2-8, Page 4.

Figures 8, 12, and 13 illustrate a template design made of two parallel, stacked, or slanted nanotubes.

Figures 9, 10, and 11 illustrate templates in non-homogeneous substrate. The substrate in Figure 9 has a continuous doping gradient. The substrate in Figure 10 has a discrete doping gradient and multiple layers of substrate. The substrate in Figure 11 has a discrete doping gradient and multiple bricks or elements of substrate.

Applicant requests the Examiner reconsider the division of the species based on the above remarks. Given the remarks above, Applicant elects Species 1.

Applicant believes the remarks submitted adequately respond to the Examiner's Restriction Requirement. Should the Examiner wish to discuss this matter further, please do not hesitate to contact me.

Respectfully submitted,

VMancevski

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